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14. ABSTRACT

While Operations Analysis is routinely used at major shore commands to help support future programmatic decisions and determine lessons learned from post-combat analysis, it is rarely used at the operational level and specifically at the JTF. To improve JTF effectiveness and enhance operational planning efficiency, JTFs warrant an Operations Analyst (the JTF Combat Analyst) capable of employing analytical models, methods and techniques. Operations Analysis dates back to World War II and it originated in the North Atlantic when the allies were trying to protect convoys from ruthless German wolfpacs. A Combat Analyst is a pro-active planner who applies analytical tools and critical thinking in order to frame alternatives and aid the warfighting commander make effective decisions based on sound analytical analysis. Using different analytical tools, a Combat Analyst contributes during both the Deliberate Planning Process and Crisis Action Planning. A Combat Analyst assist the JTF Commander in determining objectives, measures of effectiveness, expected results from various COAS and make educated estimates of potential enemy COAs. A requirement exists for real time, fast and accurate combat analysis at the JTF. A Combat Analyst is the solution.

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IMPROVING JOINT TASK FORCE EFFECTIVENESS BY CREATING A JTF "COMBAT ANALYST"

By

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CDR USN

A paper submitted to the faculty of the Naval War College in partial satisfaction of the requirements of the Department of Joint Military Operations.

The contents of this paper reflect my own personal views and are not necessarily endorsed by the Naval War College or the Department of the Navy.

Signature: _____

(17 May, 2005)

Abstract

While Operations Analysis is routinely used at major shore commands to help support future programmatic decisions and determine lessons learned from post-combat analysis, it is rarely used at the operational level and specifically at the JTF. To improve JTF effectiveness and enhance operational planning efficiency, JTFs warrant an Operations Analyst (the JTF Combat Analyst) capable of employing analytical models, methods and techniques. Operations Analysis dates back to World War II and it originated in the North Atlantic when the allies were trying to protect convoys from ruthless German wolfpacks. A Combat Analyst is a pro-active planner who applies analytical tools and critical thinking in order to frame alternatives and aid the warfighting commander make effective decisions based on sound analytical analysis. Using different analytical tools, a Combat Analyst contributes during both the Deliberate Planning Process and Crisis Action Planning. A Combat Analyst assist the JTF Commander in determining objectives, measures of effectiveness, expected results from various COAS and make educated estimates of potential enemy COAs. A requirement exists for real time, fast and accurate combat analysis at the JTF. A Combat Analyst is the solution.

Introduction

While major military staffs use Systems and Operations Analysis to determine future requirements and conduct post-conflict analysis, Operations Analysis (OA) is rarely employed at the operational level by warfighting commanders. A Joint Task Force (JTF) should, through analytical reasoning, be able to rapidly determine a bounded solution and possible outcomes which can be further refined or altered with other courses of action (COAs) to determine the most favorable plan based on sound analytical calculations. Using OA, a "Combat Analyst" can do all this and frame the alternatives to aid the JTF Commander and improve COA selection effectiveness. **To improve JTF effectiveness and enhance operational planning efficiency, JTFs require an Operational Analyst (the JTF "Combat Analyst") capable of employing analytical models, methods and techniques.**

Why is it so important to have a Combat Analyst at a JTF? Consider the definition of war and whether war is an art or science? This debate has gone on and will continue for years. The U.S. Naval War College Strategy and Policy Department classify war as art. Even General Sun Tzu's epochal text is titled *The Art of War*. Whether war is art or science is irrelevant. Science, within the context of war, must be examined and exploited in order to improve the chance of victory. Sun Tzu understood the importance of linking science to warfare. "With many calculations, one can win; with few one cannot. How much less chance of victory has one who makes none at all! By this means I examine the situation and the outcome will be clearly apparent."[1] By science, I am referring to Systems, and more importantly, Operations Analysis.

Sun Tzu is not the only one who recognizes the importance of pairing warfighting commanders with analytical tools. "Over the course of the last year, Admiral Vern Clark, the Chief of Naval Operations, has made it clear to the President of the Naval War College that there is a need for more officers with the capability to apply analytical rigor to warfighting and force planning issues."[2]

What is a "Combat Analyst"

In order to justify an additional billet (the JTF Combat Analyst) in an already resource constrained environment, it is important to clearly define the "JTF Combat Analyst", describe OA and detail exactly how a Combat Analyst can improve JTF effectiveness by implementing OA. Additionally, I will investigate current military Operations Analysts and the methods they use to determine if such capabilities already exist in the U.S. Military.

"A Combat Analyst is a pro-active crisis-planning operator capable of applying critical thinking and problem solving techniques to war fighting environments at the Joint Task Force level (not to be confused with an analyst of combat)."[3] In my vision, Combat Analysts are assigned to and work side by side with the J3. They assist decision makers throughout the JOPES process and go to work as soon as the warning order arrives. Based on the assigned mission's nature, the Combat Analyst will select an analytical tool or method to help frame the problem and alternatives in order to clearly define the problem's character and improve the decision making process effectiveness.

OA dates back to World War II and it originated in the North Atlantic when the allies were trying to protect convoys from ruthless German wolfpacks. Several scientist and engineers got together and applied statistics, physics and mathematics to difficult operational problems. OA was used in ASW, radar and air operations. Examples of OA in modern warfare include the Vietnam War "body counts," Gulf War strikes, complex logistics scheduling and post-conflict analysis. Today, Joint Doctrine defines OA as "the analytical study of military problems undertaken to provide responsible commanders and staff agencies with a scientific basis for decisions on action to improve military operations (also called operational research)."[4]

Military Operations Analysts

The Navy produces and employs two different types of Operations Analysts; the Center for Naval Analysis (CNA) and the Naval Post Graduate School (NPS). CNA analysts are

collocated at major Naval shore commands and specifically at OPNAV N81 in the Pentagon. CNA primarily conducts studies to support future program requirements and post combat analysis to identify lessons learned. As diverse as CNA studies are, few support Crisis Action Planning at the operational level. CNA analysts are analysts of combat, not "*Combat Analysts*".

Naval Post Graduate School (NPS) offers degrees in Operations Analysis and Systems Engineering. The curriculum is sponsored by OPNAV N81 and students earn a subspecialty code. Upon completion, "NPS graduates may be detailed to the following: Defense Resources Management, JCS Analyst, BUPERS, Naval War College, OPNAV Analyst, OSD Analyst, or as a Warfare Analyst."[5] More often than not, NPS graduates return to their original community and rarely are assigned as a Combat Analyst at a JTF staff.

The Army has Functional Area 49 analysts (FA-49). "An operational analysis officer conducts or supervises the conduct of qualitative and quantitative analysis of complex military and military-related problems by application of the analytical techniques and methodology of operations research/systems analysis. He applies objective, analytical and orderly thinking, supported by selected research tools (mathematical, statistical or economic) to the analysis of complex operational, organizational and management problems."[6] Similar to CNA analysts, FA-49 analysts primarily work at major Army commands. They are excellent analysts capable of developing different models and simulations and utilizing statistics and other analytical tools. However, few FA-49 analysts are detailed to the JTF. When an FA-49 does get assigned to a JTF, he is stashed away in a tent full of computers and of little utility to the JTF. Very few FA-49 analysts are utilized as true Combat Analysts.

The Air Force also has Operations Analysts. Air Force officers obtain their OA training at either Air Force schools or civilian universities, and they perform the same type of work as FA-49 analysts. The Air Force also uses RAND, a civilian organization similar to

CNA. However, just like the Navy and Army, Air Force Operations Analysts focus on future requirements, post-combat lessons learned and are typically not assigned to JTFs.

Available Analysis Tools and Models

Operations Analysts utilize several different types of models and simulations. The following represents a small sample of available campaign models; Concepts Evaluation Model (CEM, Army), Integrated Theater Engagement Model (ITEM, Navy), Joint Integrated Combat Model (JICM, RAND), TACtical WARfare (TACWAR, Joint), and the Joint Warfare System (JWARS, also Joint). There are several other engagement, mission level, theater level and engineering models available. While these large and complex models are very useful in determining future requirements and during the Deliberate Planning Process, they are of limited utility to a JTF during time constrained Crisis Action Planning.

Joint Doctrine and Operations Analysis

Having identified the different types of military analysts and available models, next we consider how Joint Doctrine recommend analytical analysis be incorporated into strategy and the planning process. Sun Tzu had his own way of linking analysis to strategy, "Consequently, the art of using troops is this: When ten to the enemy's one, surround him; When five times his strength, attack him; If double his strength, divide him; If equally matched you may engage him; If weaker numerically, be capable of withdrawing."[7]

More contemporary Joint Doctrine defines strategy as "The art and science of developing and employing instruments of national power in a synchronized and integrated fashion to achieve theater, national, and/or multinational objectives."[8] Science, or more appropriately, analytical analysis, is incorporated throughout the Deliberate Planning Process. In Phase II, Concept Development, "alternative Courses of Action (COAs) are wargamed, analyzed, and compared to produce a commander's estimate containing the commander's decision on the preferred COA."[9] During COA analysis, staffs investigate data for the synchronization matrix, identify branch plans, designate high value targets and conduct

wargaming. "Wargaming is a key analytical tool because it represents a conscious attempt to visualize the flow of the campaign or major operation, given the joint force strengths and dispositions, adversary assets and possible COAs, and the theater or joint operations area."[10] When planners have up to 6 months to prepare, it is easier to wargame and integrate OA into the Deliberate Planning Process.

Using analytical tools, a Combat Analyst contributes during both the Deliberate Planning Process and Crisis Action Planning. "At each phase of the Joint Planning Process the future Combat Analyst can make positive contributions. In COA formulation, knowledge of campaign analysis, networks, search theory, and game theory can assist in producing feasible alternatives while wargaming, simulation, and decision theory can help evaluate the formulated courses of action and produce final recommendations for plan development."[11] Clearly Joint Doctrine supports and recommends incorporating analytical analysis. The implementing details and to what extent analysis is used is largely left to the individual commands.

OA and the Combat Analyst at the JTF

We have seen how OA is effectively utilized at major staffs and during the time-generous Deliberate Planning Process. What about time-deprived Crisis Action Planning? In a crisis, COAs are still analyzed, compared and wargamed, only in much less time, preventing large modeling and simulation efforts from being used in the planning process. This is exactly the type of situation Combat Analysts are designed to handle.

What exactly does the Combat Analyst bring to the JTF? In addition to the discussed campaign and engagement models, they are proficient at several other types of models and analytical methods. Combat Analysts understand Lanchester equations, both the linear and square laws. Using these equations he can rapidly bound possible exchange rates given expectations of blue and enemy force strengths and force effectiveness. Combat Analysts understand pay-off matrices and decision tree analysis and can use both to help determine probabilities, calculate expected values, estimate enemy COAs and provide the expected value

of our own action. With linear programming a Combat Analyst can design and build models to help solve logistic scheduling problems and help direct scarce ISR assets. Combat Analysts understand Salvo equations, Game Theory and several other tools which significantly aid decision makers with the most complex decisions.

A Combat Analyst's utility is in selecting the correct analytical method or tool to frame the alternatives for the JTF Commander. There are several tools available and a "specific OA tools' value is dependent on the problem's nature to which they are applied."[12] Combat Analysts assist the JTF Commander in determining objectives, measures of effectiveness, expected results from various COAs and make educated estimates of potential enemy COAs.

A Combat Analyst also has an analytical way of thinking which is often the most useful to the JTF staff. By applying an analytical framework, the Combat Analyst can help improve the JTF's problem solving methods. "For example, during the Commander's Estimate, his education in problem formulation and critical thinking can help derive centers of gravity, decisive points, objectives, and task."[13]

Specific OA Examples

Next we explore specific examples detailing a Combat Analyst's utility to the JTF. Each example demonstrates a different technique and how it can be applied. Specifically I will look at Lanchester equations, Theater Ballistic Missile Defense (TBMD) and mine warfare.

1. Lanchester Equations and Exchange Rations

I will start with Lanchester equations because they are straightforward and perhaps the most widely known. While some argue their simplicity diminishes their usefulness, they are still a good starting point to help us understand what OA can provide the JTF Commander. Often, the simpler an analysis, the more useful it is to a JTF Commander.

Consider a JTF tasked to secure an inland objective with a blue force 1,200 strong. J3 and J5 planners estimate blue force advantage ranges from 10:1 to 3:1 and as many as 2,000 enemy combatants will be opposing the blue force. Using Lanchester's linear and square law

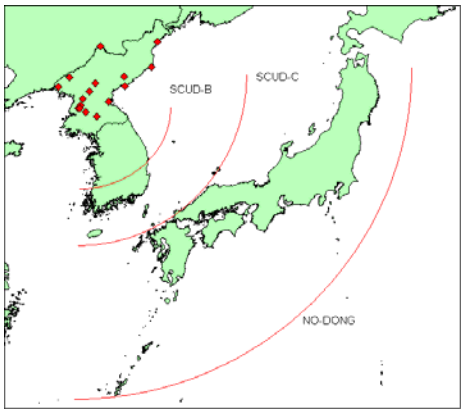
we can calculate a blue force casualty range. Best case, blue force will suffer 120 casualties (using a 10:1 advantage and linear law) and worst case, 640 casualties (3:1 advantage and square law). This simple calculation can be done in minutes and helps guide COA selection early in the Crisis Action Planning.

In some cases, Lanchester's square law provides a better estimate if the fires are aimed rather than random. Our example also demonstrates it's possible to combine the linear and square laws. "S. J. Deitchman suggested using the combination of Lanchester's linear and square laws to model the outcome of a battle where only one force is able to concentrate or aim its fire."[14] Using these laws it's possible to calculate expected winners and losers, final force strengths and the critical value of a force's fire (the rate of fire at which the battle outcome changes).

Combat Analysts can apply this type of analysis very early in the planning phase to help determine necessary force strength. In some cases, the Lanchester equations may yield a significantly high blue force casualty rate. In such a case, the JTF Commander may consider alternatives to the conventional blue forces. He could decide to send Army SOF teams, delay until he has sufficient force or choose to fight defensively vice offensively. By employing OA, the Combat Analyst helps the JTF Commander choose an analytically sound and logically sequenced COA.

2. TBMD, Optimization Model

Theater Ballistic Missile Defense (TBMD) demonstrates a more complex OA example.



(North Korea Launch Sites and Missile Ranges)[15]

Consider North Korea in 2010. By that time the North Koreans should have completed their Taepo' Dong I and II missiles with ranges of 2000 and 5500km respectively. With at least 15 different launch sites, all the different missile types, and an already confirmed nuclear weapons capability, North Korea will possess a fearsome offensive nuclear strike capability.

By 2010 the U.S. will most likely have fielded 3 different systems capable of intercepting North Korean missiles: Patriot missile defense system, Theater High Altitude Area Defense (THAAD) and AEGIS Theater Missile Defense (TMD). Consider a JTF Commander tasked with providing TBMD against North Korean missile attacks. Assume assigned JTF forces include 2 AEGIS cruisers each with 10 SM3 and 20 SM2 interceptors, one Destroyer with 20 SM2 interceptors, one Army THAAD battery with 10 interceptors and one Army PATRIOT battery with 8 launch vehicles.

Next consider all the possible variables associated with planning a defense against a North Korea missile attack. Planners would need to consider the number and locations of launchers, anticipated number of missiles launched, ranges of missiles launched, ranges to intended targets, location, number and type of defending assets, and defended asset priorities. The literally thousands of variables lead to countless scenarios.

Commanders of Army missile defense batteries and TMD ships all understand how best to tactically employ their unique defensive systems. However, it is highly unlikely that Army commanders understand the best location for a DDG and visa versa. Additionally, commanders of TBMD assets will have limited defended asset priority visibility. For example, let's assume several western leaders are meeting in Tokyo, thereby greatly increasing the importance of defending that city. How do commanders of TBMD assets alter their tactics to account for Tokyo's increase in priority? Similarly, how do PATRIOT and THAAD batteries respond when a TMD ship goes off station to conduct emergent repairs? And finally, how

does the JTF Commander account for the fact that ships are far easier to reposition than a Patriot or THAAD battery?

The numerous variables, countless situations and ever changing priorities lead to a difficult problem. Not to mention the stakes are extremely high. If the JTF Commander places his assets in the wrong place, a North Korean nuclear ballistic missile attack could be successful. How can the JTF-TBMD Commander ever hope to achieve an optimal solution? Seems like an impossible problem to solve.

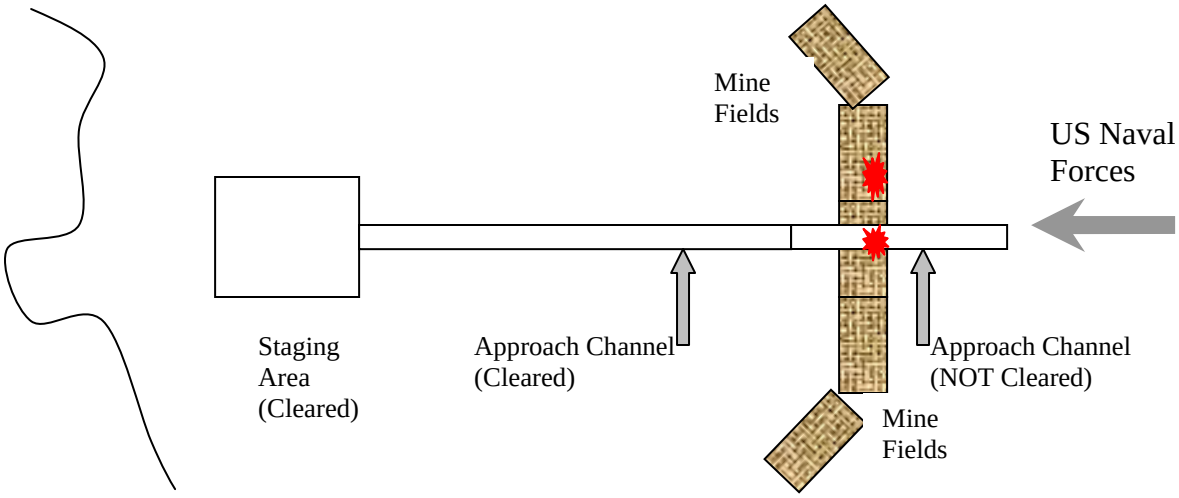
A Combat Analyst armed with an operational planning tool based on optimization called "Joint Defender" can solve the problem. Joint Defender uses "inputs and data similar to previous planning systems and solves the TBMD problem as mathematical optimization producing an optimal solution."[16] An analyst inputs the threat missiles, launch locations, defended asset priorities and status of defending platforms. The model provides optimal defending asset locations and the threat missile engagement plans.

Joint Defender is a powerful tool. Consider a biweekly meeting where the JTF Commander meets with his Land and Maritime components, J2, J3, his POLMIL advisor and of course his Combat Analyst. During the meeting, POLMIL advises of any possible changes in defended asset priority, Maritime and Land components provide status of all TBMD assets and any expected down times, and J2 provides updated status on North Korean missiles and launch sites. All the while the Combat Analyst is updating Joint Defender such that when all briefs are completed, he provides the recommended position and condition of all TBMD defending assets. The JTF staff reviews the optimized solution for accuracy, makes any additional changes and rechecks the solution as necessary. As the JTF implements the plan, they can be confident their solution is optimized with the provided critical variables and that there is no better solution.

3. Mine Warfare, an Analytical Approach

A Combat Analyst does more than design models and solve difficult math problems. A Combat Analyst understands how to apply an analytical framework in order to establish a clear and logical sequenced approached to the problem. "The Combat Analyst's best contribution to a JTF staff is one of problem formulation and critical thinking."[17]

During the first Gulf War, two U.S. Navy ships were severely damaged by Iraqi mines. The ships struck the mines after the area had already been swept for mines. What happened?



After the fact it is easy to see the mine clearing operations completely missed the mine fields. The Iraqi Navy planted over 1,200 mines. The U.S. Navy knew that the Iraqis were laying the mines. However, in order to avoid escalation, the Navy did not oppose Iraqi mine field planting operations. Additionally, the Navy did not actively track the Iraqi mine laying ships. As such, when mine counter measure (MCM) operations commenced, they had no idea where the fields were located. Furthermore, MCM forces did not verify the mine field locations. Subsequently, two U.S. Navy ships (USS TRIPOLI and USS PRINCETON) became mine sweepers and pinpointed the exact location.

Following the war, CNA completed a study titled The Mine Threat: Show Stoppers or Speed Bumps? In the study, "the authors step back from the details to provide their personal perspective on the nature of the mine threat and how the Navy can avoid repetition of recent and previous bad experiences with attempts to counter mines."[18] The study effectively

demonstrates how to apply an analytical approach to a difficult problem. The study avoided difficult and complex calculations while providing a logical and sequenced analytical approach to solve the mine field problem. "An effective countermine campaign will do more than simple mine clearing. It will encompass the four general ways to deal with mines: Prevent the enemy from laying them in the first place, avoid the mines, clear the mines, and "Press on" despite some risk."[19] This example demonstrates that to be effective, a Combat Analyst need not always employ complex mathematical models and equations.

Counter Point

The question arises, does OA really matter and can it truly make a difference? Even Clausewitz questioned the utility of pairing science with warfare commanders. "Absolute, so-called *mathematical factors never* find a firm basis in military calculations. From the very start there is an interplay of possibilities, probabilities, good luck and bad that weaves its way throughout the length and breadth of the tapestry. In the whole range of human activities, war most closely resembles a game of cards. It must always leave a margin for uncertainty, in the greatest things as much as in the smallest."[20]

Many Joint Doctrine and planning experts consider OA too cumbersome and of limited utility. Skeptics agree models are too complicated to be useful on the battle field. Others believe JOPES is a sufficient planning tool and since most assigned assets are limited, the JTF Commander's only option is to accept his assigned forces and no analysis will change that fact.

Additionally, every military officer understands algebra and basic statistics, thereby further diminishing the requirement for Combat Analyst. For example, consider a simple and routine ground operation that requires 90 trucks. The trucks will transport an infantry battalion 200 miles to and from the main objective. From past experience, J3 knows the trucks have a 90% reliability rate for a 200 mile trip. J3 orders 100 trucks from the motor pool. During the CONOPS brief, J3 briefs that 100 trucks are necessary to ensure at least 90 trucks (.9 x 100 = 90) complete the operation. The JTF Commander agrees and the mission is conducted the

following day. During the mission, 8 trucks break down, leaving 92 to successfully accomplish the mission.

Clearly J3 understood the utility of expected value and reliability rates. This example proves a Combat Analyst is not required at the JTF. However, that's not the end of the story. A Combat Analyst completely agrees with J3's reliability rate and expected value calculation. However, a Combat Analyst would take the analysis one step further and recognize the reliability rate is only an average. It's a compellation of several trials which averaged out to 90%. Therefore, about half the time fewer than 10 trucks break down during the mission. More importantly, about half the time more than 10 trucks break down.

If 11 trucks fail, the mission fails. Therefore, considering the trucks' reliability rate, the JTF's probability of success was only slightly better than 50%. Few JTF Commanders would embark on a mission with such a low probability of success. Assuming that most JTFs don't press the analysis to this point, how do they manage to successfully complete mission after mission? The truck example is simple. Every motor pool sergeant understands the necessity of on hand ready service spares and never leaves camp without an adequate surplus. Broken trucks are rapidly repaired, thereby ensuring truck reliability rates do not hamper mission success. But what if the mission is more complicated than the truck example? What if the mission involved more complex machinery like helicopters which also happen to be in shorter supply than the trucks? What happens when the JTF commander relies upon expected values in such a case? Such a thing did happen in 1980 with Operation Eagle Claw, the aborted Iran hostage rescue.

An ad hoc team consisting of 20 aircraft was assembled from all four services. Aircraft included 10 different types of C-130s, 2 C-141s and 8 RH-53s. The team was to assemble at the forward staging area, Desert One. After refueling and onloading, the RH-53s were to fly to Tehran, off load the Delta team, hide in the area and wait for the scheduled extraction the

following night. Each RH-53 could hold 55 passengers. In order to evacuate the hostages, the Delta team, and in-country personnel, 6 RH-53 were required.

"For planning purposes, each helicopter was given a 75% chance of completing the operation without a failure requiring a mission abort."[21] With a 75% reliability rate, and 6 of 8 helicopters required for the mission, a rough estimate indicates that about half the time, 2 or less helicopters will fail. More importantly, about half the time, 3 or more will fail. It's difficult to determine whether planners understood the true value behind the 75% reliability rate. What we do know is that "Colonel Beckwith, the mission commander, had asked for 10 RH-53s. The Navy only provided 8, claiming that the carrier could only store 8 on the hangar deck."[22]

The order was given and the mission commenced. The task force encountered a haboob and two helicopters landed when they lost sight of the formation. These two eventually did rendezvous at Desert One. However, two other helicopters aborted due to aircraft warning lights. Once at Desert One, the task force was already down to 6 helicopters. One of the 6 remaining helicopters experienced a hydraulic leak leaving only 5 RH-53s. The mission was aborted and the task force began to depart. While refueling and preparing to depart, a helicopter hit an EC-130 and chaos ensued.

Considering the number of RH-53s and their assigned reliability rate, planners should not have been overly surprised by the outcome. The probability of reaching mission abort criteria, losing 3 or more helicopters, was relatively high. What exactly was the probability that 3 or more helicopters would fail? To answer this, we will us a binomial distribution. A binomial is a probability distribution made up of independent trails and more importantly answers the questions "*How many "successes" can be expected in a number of trials*". Using the binomial and a reliability rate, a JTF Commander can determine how many resources he wants to apply to ensure a certain or specific confidence of success. With a binomial we can determine the probability that 6 or more of the helicopters would complete the mission. The

binomial, imbedded in Excel, indicates a 67% (.31 + .36) chance that 6 or more helicopters would complete the mission.

(Combat Binomial Work Sheet) [23]

Had 10 RH-53s been used instead of 8, the probability that 6 or more would complete the mission would have been around 91%. As expected, a better chance of completing the mission.

What conclusion can we draw from Operation Eagle Claw? It is difficult to say that a Combat Analyst would have prevented the doomed mission. "There was no redundancy in the C-141s, the MC-130, or the 6 helicopters once they arrived in Tehran. There were many more chances for things to go wrong in just the aviation support, let alone the tactical part of the mission."[24] Clearly there were several other factors at play. However, the Combat Analyst would have correctly pointed out that with 8 helicopters there was only a 67% chance that 6 or more would complete the mission. Had the JTF Commander understood the low probability of success he very well may have insisted on 10 helicopters. Whether 10 helicopters would have made a difference is difficult to determine. However, had 10 helicopters been used instead of 8, the JTF Commander would have had more options available and the outcome may have been different.

OA and the Combat Analyst is not the final solution to all problems a JTF commander will encounter. Nevertheless, they do add value by assisting the JTF Commander with difficult

decisions, evaluating on-going operations, and applying knowledge and a logical sequenced analytical approach. If Clausewitz had a Combat Analyst, his "margin for uncertainty" may have been better defined and he might have given more consideration to mathematical factors.

Conclusion

To summarize, war can be classified as art, however, decisions made within it can be aided by scientific methods. OA served the military well in the past when it helped defeat the Germans in WWII and identify targets in the Gulf War. All services do an outstanding job conducting programmatic analysis and analysis of combat, however, none do well at integrating OA at the operational level or at the JTF. The Deliberate Planning Process has the luxury of time and can therefore include more detailed analysis. Crisis Action Planning, on the other hand, does not allow sufficient time to conduct the conventional analysis used in Deliberate Planning. A requirement exists for real time, fast and accurate, combat analysis at the JTF level.

A Combat Analyst is just that, a pro-active planner who applies analytical tools and critical thinking in order to frame alternatives and assist the warfighting commander in making difficult decisions. Combat Analysts have lots of tools, some are good and some not so good, and it all depends on the nature of the problem. The true test of a Combat Analyst is if he can select the proper method to accurately frame alternatives, provide clarity, and assist the JTF Commander make effective decisions based on sound analytical judgment.

Observations and Recommendations

Considering all the facts, I see two major areas that require improvement at the operational level and specifically at JTFs.

First, improve the analytical planning process at JTFs. Apply an analytical framework similar to the one discussed in the mine warfare example. The JTF operations I observed were haphazardly thrown together at the last minute, required a significant amount of "bubble gum

and shoe string," and would have benefited from a solid analytical structure. I recommend starting with something similar to the following approach.

1. Problem formulation. Define the true nature of the problem.
2. Identify Objectives, Measures of Effectiveness (MOE), Boundaries and Constraints.
3. Identify alternatives. What other possibilities exist?
4. Identify variables that impact alternatives.
5. Decide on the method and generate a model.
6. Conduct analysis.
7. Evaluate alternatives and compare.
8. Conduct sensitivity tests to develop confidence.
9. Conduct operational trails or observations.
10. Communicate the results.

Secondly, JTFs need to incorporate and utilize various analytical tools. Recall that a model's solution is only as good as the model from which it came and therefore, commanders need to be involved in the process so that the true problem is identified, MOEs are accurate and priorities are established. Otherwise, the model will not provide acceptable results. OA is a set of tools used to aid decision makers, not make decisions for them.

A JTF Combat Analyst is the perfect fit to fill both of these requirements. As already discussed, the military has the people trained. It would take little effort to turn a NPS graduate or FA-49 analyst into a full time JTF Combat Analyst. Additionally, most JTFs already have Operations Analysts on staff. A typical JTF has a tent full of FA-49 analysts working away at their computers. My solution would have one or two of those analysts transferred to the J3 to perform the Combat Analyst duties. Supporting Joint Doctrine would need to be modified in order to detail the exact duties, responsibilities and capabilities of the Combat Analyst.

If JTFs can support Combat Camera, why not a Combat Analyst? When fighting a war and taking risks, the JTF Commander has the responsibility to his staff and his assigned forces

to ensure that all possibilities have been explored in order to complete the assigned task in the safest manner possible while, to the best extent possible, minimizing the operational risk. By not employing OA or a Combat Analyst, the JTF Commander is not taking full advantage of all the available tools and may be unnecessarily risking his forces. There genuinely is a significant requirement for Combat Analysts on JTF staffs and *NOW* is the time to get them there.

In closing, if still not convinced we need to link OA with the warfighting commander and that Combat Analysts are necessary at JTFs, consider this, "We are 15+ years too late for Desert One, but we should make sure this generation of officers can do probabilistic military planning. We owe it to the ghosts of the 8 men who died on the desert floor."[25]

Notes

[1] Sun Tzu, The Art of War (Samuel B. Griffith, trans, Oxford University Press, 1980), 71.

[2] James F. Giblin, Jr. to James L. Christie, 30 June 2004, Naval War College, "Letter to James L. Christie," Newport, RI.

[3] Jeff Kline, "Combat Analyst," (Unpublished Research Paper, U.S. Naval Post Graduate School, Monterey, Ca: 2004), 1.

[4] Joint Chiefs of Staff, Department of Defense Dictionary of Military and Associated Terms, Joint Pub 1-02 (Washington, DC: 12 April 2001), 391.

[5] "Operations Analysis Subspecialty." Operations Research Department Naval Postgraduate School. 3 April 2003. < http://www.nps.navy.mil/or/students/c360.htm > [10 April 2005].

[6] Department of the Army, Functional Area 49 Operations Research/Systems Analysis, Pamphlet 600-3-49 (Washington, DC: 1 August 1987), 2.

[7] Sun Tzu, The Art of War (Samuel B. Griffith, trans. Oxford University Press, 1980), 79.

[8] Joint Chiefs of Staff, Department of Defense Dictionary of Military and Associated Terms, Joint Pub 1-02 (Washington, DC: 12 April 2001), 509.

[9] Norman M. Wade, ed., The Joint Force & Operational Warfighting SMARTbook (Lakeland, Lightning Press, 2003), 4-14.

[10] Ibid., 4-18.

[11] Jeff Kline, "Combat Analyst," (Unpublished Research Paper, U.S. Naval Post Graduate School, Monterey, Ca: 2004), 2.

[12] Ibid., 3.

[13] Ibid., 2.

[14] William Pendegrass, Combat Analysis for Command, Control and Communications: A Primer, Technical Report, (Monterey, CA: 1993), 70.

[15] Douglas D. Diehl, "How To Optimize Joint Theater Ballistic Missile Defense Joint Defender," (Unpublished Research Paper, U.S. Naval Post Graduate School, Monterey, CA: 2003), 7.

[16] Ibid., 17.

[17] Jeff Kline, "Combat Analyst," (Unpublished Research Paper, U.S. Naval Post Graduate School, Monterey, Ca: 2004), 3.

[18] Center for Naval Analyses, Naval Studies Group, The Mine Threat: Show Stoppers or Speed Bumps, Occasional Paper (Alexandria, VA: 1993), ii.

[19] Ibid., 15.

[20] Carl von Clausewitz, On War (Michael Howard and Peter Paret eds. and trans. Princeton: Princeton University Press, 1989), 86.

[21] Johnson, "Analysis Report Operation Eagle Claw," (Unpublished Analysis Report, Joint Task Force Cormorant: 1998), 2.

[22] Ibid., 2.

[23] Jeff Kline, "Computing Binomials," (Unpublished Research Paper, U.S. Naval Post Graduate School, Monterey, CA: 2004), 7.

[24] Johnson, "Analysis Report Operation Eagle Claw," (Unpublished Analysis Report, Joint Task Force Cormorant: 1998), 4.

[25] Ibid., 26.

Bibliography

Center for Naval Analyses. Naval Studies Group. The Mine Threat: Show Stoppers or Speed Bumps. Occasional Paper. Alexandria, VA: 1993.

Clausewitz, Carl von. On War. Michael Howard and Peter Paret eds. and trans. Princeton: Princeton University Press, 1989.

Diehl, Douglas D. "How To Optimize Joint Theater Ballistic Missile Defense Joint Defender." Unpublished Research Paper, U.S. Naval Post Graduate School, Monterey, CA: 2003.

Ewell, Julian and Ira A. Hunt, Jr. Sharpening the Combat Edge: The use of Analysis to Reinforce Military Judgment. Department of the Army. Washington, DC: 1974.

Giblin, James F. Jr., to James L. Christie. 30 June 2004. Naval War College. "Letter to James L. Christie." Newport, RI.

Hoeber, Francis, P. Military Applications of Modeling: Selected Case Studies. New York: Breach Science Publishers, 1981.

Johnson. "Analysis Report Operation Eagle Claw." Unpublished Analysis Report, Joint Task Force Cormorant: 1998.

Kline, Jeff. "Combat Analyst." Unpublished Research Paper, U.S. Naval Post Graduate School, Monterey, Ca: 2004.

Kline, Jeff. "Computing Binomials." Unpublished Research Paper, U.S. Naval Post Graduate School, Monterey, CA: 2004.

Morse, Philip M. and George E. Kimball. Operations Research. New York: John Wiley & Sons: 1951.

"Operations Analysis Subspecialty." Operations Research Department Naval Postgraduate School. 3 April 2003. < http://www.nps.navy.mil/or/students/c360.htm > [10 April 2005].

Pendegrass, William. Combat Analysis for Command, Control and Communications: A Primer. Technical Report. Monterey, CA: 1993.

Perla, Peter P. The Art of Wargaming, A Guide for Professionals and Hobbyists. Annapolis, Maryland: Naval Institute Pres, 1990.

Tzu, Sun. The Art of War. Samuel B. Griffith, trans. Oxford University Press, 1980.

U.S. Department of the Army. Functional Area 49 Operations Research/Systems Analysis. Pamphlet 600-3-49. Washington, DC: 1 August 1987.

U.S. Joint Chiefs of Staff. Department of Defense Dictionary of Military and Associated Terms. Joint Pub 1-02. Washington, DC: 12 April 2001.

Wade, Norman M., ed. The Joint Force & Operational Warfighting SMARTbook. Lakeland, Lightning Press, 2003.

Wagner, Daniel H. and Charles Mylander and Thomas J. Sanders. Naval Operations Analysis. 3rd ed. Annapolis, Maryland: 1990.